Time Resolved Diffraction Measurement with an Imaging Plate at High Pressure and Temperature	X17B1

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An imaging plate (IP) has great potential to acquire high quality in situ x-ray diffraction data at high pressure and temperature in both a diamond anvil cell (DAC) [1-2] and large volume apparatus [3-4]. The off-line developing of an imaging plate is a disadvantage for quick data collections. Effords have been made to install an on-lone imaging plate scanner for reducing the operation time. Time resolution in the sequence of consecutive exposures is on the order of tens of minutes. Recently rapid development of a CCD (charge coupled device) provides a good opportunity to perform time resolved data collection. Nevertheless, the current commercial CCD has very limited active detecting area ($\sim$50 x 50 mm^2) which results in a relative low resolution when the CCD is used to record a large-range d-spacing pattern. We have developed a translating imaging plate system (TIPS) with the large-volume multi-anvil apparatus SAM85 at the beamline X17B1 to acquire time resolved diffraction.

We introduced a lead screen with a vertical slit in the middle in the front of the imaging plate to define the dimension of exposure on the detector (Figure 1). The imaging plate holder is mounted on a horizontally motor-control stage, and the translation guide block is perpendicular to the incident x-ray beam. A 200 mm x 400 mm imaging plate is used for the data collection. Width of the slit is adjusted depending on the beam intensity, IP-to-sample distance and the transporting speed of the imaging plate. A direct beam stop is mounted on the slit. The beam stop blocks most of the intensity of the direct beam, and allows the direct beam to expose the imaging plate with the same intensity as a diffracted beam (as shown on the top of Figure 2). Olivine-spinel phase transition in fayalite was investigated with this system. Figure 2 shows a time resolved diffraction pattern recorded on the imaging plate during the phase transition. The data enable us to study the sample stresses during the phase transition and the phase transition mechanism.

[1] O. Shimomura, K. Takemura, H. Fujihisa, Y. Fujii, Y. Ohishi, T. Kikegawa, Y. Amemiya, T. Matsushita, Rev. Sci. Instrum. 63(1), 967(1992). [2] R. J. Nelmes and M. I. McMahon, J. Sunchrotron Rad. 1, 69(1994). [3] J. Chen, T. Kikegawa, O. Shimomura and H. Iwasaki, J. Synchrotron Rad. 4, 21(1997). [4] J. Chen, R. Li, J. B. Parise and D. J. Weidner, Am. Min. 81, 1519(1996).

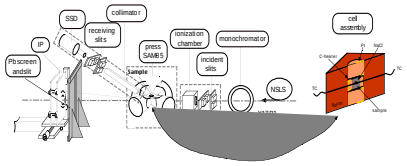

Figure 1. Schematic layout of the translating imaging plate system (TIPS) for high P-T x-ray diffraction at X17B1.

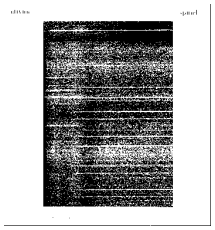

Figure 2. Diffraction pattern of fayalite recorded on an imaging plate while the sample transforms from olivine to spinel.